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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 1999		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense Wide/BA 2					R-1 ITEM NOMENCLATURE Lincoln Laboratory PE 0602234D8Z					
COST (In Millions)	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Cost to Complete	Total Cost
Total Program Element (PE) Cost	17.197	19.271	20.774	20.739	20.994	21.275	21.781	22.590	Continuing	Continuing
Lincoln Laboratory/P534	17.197	19.271	20.774	20.739	20.994	21.275	21.781	22.590	Continuing	Continuing

(U) **A. Mission Description and Budget Item Justification**(U) **BRIEF DESCRIPTION OF ELEMENT:**

(U) The Lincoln Laboratory (LL) program is a high technology research and development effort conducted through a cost reimbursable contract with the Massachusetts Institute of Technology (MIT). LL is operated as a Federally Funded Research and Development Center (FFRDC) administered by the DoD, and is unique among DoD FFRDCs. It has no funding sources other than the Line for its innovative research and development efforts. This is due to the fact that LL is operated by MIT at no fee and may not charge for IR&D (under A-21). Other DoD FFRDCs do charge a fee with which they may support research efforts.

(U) The LL funds research activities that directly lead to the development of new system concepts, new technologies, and new components and materials. Historically, funding supports many development and demonstration programs which have led to such significant DoD systems as JSTARS, MILSTAR, GEODSS, as well as to solid-state devices and processes of major importance to the military industrial base. In addition to being the foundation for many new LL programs, the funding also supports other ongoing Laboratory programs with state-of-the-art technology developments. The program has the following 4 research elements:

- Target surveillance and recognition, with emphasis on (1) revolutionary sensing techniques and algorithms for detecting and recognizing battlefield targets both in the clear and in difficult deployments, (2) supporting data collection and phenomenology, and (3) fundamental target-recognition bounds and their implications for sensor and algorithm design.

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- High-connectivity, low-cost military global defense network and communications systems, with emphasis on new antennas, RF technology, network protocols (including for mobile users with lightweight transceivers), high-rate fiber and free-space optical communications systems, and the interconnection of these very disparate modalities into a global defense network that can truly realize the vision of a “from sensor to shooter” communications infrastructure which will greatly enhance force effectiveness by providing the right information at the right time anywhere in the world;
- Advanced combat support technologies for hyperspectral sensing systems, Micro Air Vehicles for battlefield surveillance and compact biological agent detection systems. The focus in biological agent detection is in developing technology for compact, lightweight, real-time biological-agent sensors with extremely high sensitivity (> 1 agent containing particle per liter of air) and with strong background clutter rejection for extremely low false-alarm rate (> 1 per week). The primary objective for the active hyperspectral sensing system development is to demonstrate the feasibility and utility of combining active illumination with hyperspectral imaging for a range of military applications including CID.
- Revolutionary, advanced electronic/optical technology, with specific emphasis on optical sampling for direct analog-to-digital conversion on the microwave carrier in digital receivers for radar and electronic intercept, 3-D imaging and high sensitivity IR focal-plane arrays for advanced missile seekers, mid-infrared semiconductor lasers to counter advanced heat-seeking missiles, new miniature fluorescent and microfluidic sensors for rapidly detecting and identifying low concentrations of biowarfare agents, solid state low-light imagers for improved night vision under starlight illumination, and high-speed, radiation hard, ultra-low power analog and digital circuits for ubiquitous DoD applications.

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Lincoln Laboratory/P534	17.197	19.271	20.774	20.739	20.994	21.275	21.781	22.590	Continuing	Continuing

(U) **Project Number and Title: P534 Lincoln Laboratory**

(U) **PROGRAM ACCOMPLISHMENTS AND PLANS:**

(U) **FY1998 Accomplishments:**

(U) **Target Surveillance and Recognition:** (\$4.574 Million)

(U) **Surface Surveillance**

(U) Used the airborne data collection system to image large portions of Ft. Drum, NY over several seasons, creating a unique database of synthetic-aperture-radar (SAR) change phenomenology. Applied fundamental target-recognition bounds to design study of height-sensing SAR. Initiated investigation of "inverse scattering" theory for application to target-recognition in foliage penetrating SAR imagery. These activities have had direct impact on ongoing R&D activities such as Dynamic Data Base (DDB) and Radar Complex Data Exploitation (RCDE) (both DARPA); and have considerable significance for agencies such as NIMA and NRO that must plan next-generation exploitation and sensing systems.

(U) **Space Surveillance**

(U) Continued the advanced electro-optical technology program in support of the Air Force Space Control Mission. Expanded the technology development effort to include advanced electro-optical seekers for Ballistic Missile Defense. Continued the development of advanced CMOS readout multiplexers for IR focal plane arrays that will enable the improvement of FPA pixel to pixel spatial uniformity for high quantum efficiency detector materials such as InSb and HgCdTe. An FPA CMOS readout multiplexer design has been implemented; fabrication of CMOS integrated circuits for full function FPA readouts have begun. Continued the development of avalanche photo-diode (APD) array for 3-D laser radar imaging to support advanced BMD interceptor seeker concept. Four by four APD sub-arrays have been fabricated and wire bonded to 16-channel CMOS timing electronics. A 3D laser radar brassboard system has been demonstrated. The FPA technology developments will become the basis for improved seekers for the BMD community including the Navy Lower and Upper Tier Theater Ballistic Missile Defense Programs.

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(U) **Military Communications:** (\$3.484 Million)

(U) Continued to investigate globally networked military communications systems that will enable the free flow of information among disparate users and systems at rates from tens of kilobits per second to tens of gigabits per second. The targeted user community for these systems includes DoD (Air Force, Navy & Army) and the intelligence community. Technology is under development for both free-space optical communications and terrestrial fiber communications, as well as for tactical theater communications, particularly to forces on the move, and for the interconnection of satellite communications (SATCOM), terrestrial and wireless systems into a global defense network.

(U) Optical communications: Free-space optical communications technology successfully transitioned to a funded flight demonstration program. Continued work to enhance optical transmitter power and efficiency as well as near-quantum-limited optical receiver technology. Application to world-wide relay of high-rate surveillance data.

(U) Global ultra-high rate networks: Continued development and demonstration of optical technology for ultra-high rate local and metropolitan area networks (LANs and MANs). Demonstration of optical processing functions for high-speed cryptography and for packet routing in a 100 Gbps LAN/MAN. Application to processing and fusion of surveillance data.

(U) Tactical Satellite Terminals: Continued development of electromagnetically-steered phased array antennas utilizing optical fiber and electro-optical technologies that offer light weight, low cost fabrication and integration on tactical platforms. Completed development of architecture and plans for integration of transmit and receive arrays. Continue implementation of an 8 GHz receive array. Application to ground forces communication on the move and to aircraft.

(U) Defensive Information Warfare: Developed and demonstrated a prototype protocol for dynamic reconfiguration in a network conferencing application, to confuse potential network attackers. Developed a network for realistic simulation of actual attacks and anomalous usage, mixed with normal network background traffic, in order to evaluate objectively the performance of existing and developmental intrusion detection systems.

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(U) **Combat Support Technology:** (\$2.903 Million)

(U) Designed and developed a baseline active hyperspectral imaging (HSI) system that incorporates a VIS/NIR white-light “laser” illuminator on a scanning, tripod-mountable platform with a compact imaging spectrometer. The system was successfully tested in a series of laboratory experiments to demonstrate utility in detection and identification of concealed targets in a low-light, highly-cluttered environment. A series of outdoor tests designed to verify performance in concealed target detection and demonstrate range-gating ability are planned. Applications for the baseline system include man or vehicle vision enhancement, mine detection, and optical taggant discrimination.

(U) To improve the performance of UV fluorescence-based biological-agent sensors a large number of agent stimulants and background substances (pollens, mold spores, etc.) were measured in an aerosol chamber. In addition, field measurements of background clutter continued. These lab and field measurements have led to the development of a three-channel sensor for the Army, with considerably enhanced discrimination capability as compared to the previous two-channel sensor. Work was initiated in networking sensors together, both in simulations and for real-time sensing and discrimination. Also, development of a biological identifier accelerated with the addition of DARPA support. Immunological B-cells are being tailored and introduced into microfluidic chambers, which will analyze samples selected by the alarm device. Each cell fluoresces in response to a specific antibody and thereby will provide rapid identification of agents.

(U) Several fixed-wing Micro Air Vehicle (MAV) airframe configurations were tested in a wind tunnel to evaluate electric propulsion performance and the effectiveness of different wing and tail arrangements. Several airframe configurations were also outfitted with radio control for flight testing. A vehicle with 10-in. wingspan flew successfully. Development of more efficient, miniature internal combustion engines continued throughout the year. Optical designs were completed for two high-resolution, visible imaging cameras. The transfer of Lincoln technology will be completed by the end of FY98.

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(U) Advanced Electronics Technology: (\$6.236 Million)

(U) The general objective of this program is to conceive, demonstrate, and provide advanced electronic devices, circuits and subsystems for Air Force and other DoD systems, and to transfer enabling technologies to industry. Principle efforts are in lasers, electro-optic devices, visible and infrared (IR) sensor arrays, analog and digital silicon integrated circuits, microwave and mm-wave devices, and superconducting electronic devices along with supporting development of materials and processing techniques. These efforts support DoD systems programs elsewhere within Lincoln Laboratory, as well as directly supporting AFRL (IR countermeasures (CM), adaptive optics, focal plane readout circuits, electro-optical space surveillance). Technology from this program is exploited by the Army and Navy ballistic missile defense programs (focal plane readout circuits), by Army EdgeWood Research Development and Engineering Center (ERDEC) (bioaerosol sensors), by DARPA (sub 0.25- μ m lithography, low-power/higher-speed CMOS circuits in silicon-on-insulator (SOI) material, high speed optical sampling for analog-to-digital (A/D) conversion, microfluidic bio-agent identifier, multichip modules) by BMDO (avalanche photodiodes for 3-D radar, GaN layers for electronics, superconductive spread spectrum modem) and NSA (superconductive crossbar switch, high-speed cryogenic memory). Technology transfer is being accomplished through direct DoD support (IR countermeasures, CMOS/SOI circuits, imaging arrays and readout circuits, superconductive filters), and through cooperative research development agreements (CRDAs) microchip UV lasers, lithographic technology, and diamond switch technology.

(U) Selected accomplishments: (1) Demonstrated high-power, high brightness lasers at 2- and 4- μ m for dual-band IR counter measure subsystem; (2) Demonstrated resonant-tunnel-diode injection-locked oscillator for stable laser driver in optically sampled A/D converter; (3) Fabricated demultiplexers for optical A/D converter; (4) Demonstrated high-accuracy, low-power charge-coupled device (CCD) as A/D converter; (5) Evaluated SOI material and initiated fabrication of merged CMOS/CCD circuit for "smart" focal planes; (6) Demonstrated 1.3- μ m-wavelength tapered laser/amplifier with low noise for compact, wide-dynamic- range, analog fiber-optic link; (7) Demonstrated multi-GHz-bandwidth superconductive compressive receiver for electronic intelligence (ELINT); (8) Fabricated > 1-GHz clock-rate SOI/CMOS data-processing circuits for ELINT receiver; (9) Demonstrated geiger-mode avalanche photodiode (APD) array with CMOS per-pixel timing circuits for 3-D radar; (10) Demonstrated antiblooming feature for extended intrascene dynamic range in CCD imager for improved night vision; (11) Continued development of miniature IR, visible and UV lasers for ranging and biodetection; (12) Designed tunable microwave filters using superconductive resonators; (13) First demonstration of avalanche photo gain in GaN.

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(U) **FY1999 Plans:**

(U) **Target Surveillance and Recognition:** (\$4.977 Million)

(U) **Surface Surveillance:**

(U) Initiate development of multichannel airborne data collection capability. Extend fundamental target-recognition bounds to high-range-resolution radar profiling for application to moving-ground-target recognition. Use synthetic foliage-penetrating radar imagery to validate target representation for inverse-scattering-based recognition techniques. Initiative investigation of active seismic characterization of underground facilities – develop computational model and validate with subscale experimentation. In addition to being directly applicable to ongoing R&D efforts such as DARPA's DDB, MTE, FOPEN and Small Unit Operations programs, these activities will have considerable significance for organizations, such as NIMA, NRO and the Services, that are planning and developing next-generation exploitation and sensing systems.

(U) **Space Surveillance:**

(U) Continue advanced focal plane technology work with emphasis on submicron and SOI CMOS device processing technologies applied to silicon monolithic read-out multiplexers for high quantum efficiency FPAs. Continue 3-D laser radar technology development with epoxy bonding of 32 x 32 APD arrays to SOI-CMOS timing electronics arrays for high sensitivity receivers. These advanced focal plane array technologies for both passive and active IR sensors will lead to new BMD interceptors with much-needed improvements in detection, acquisition and discrimination to counter increasingly challenging ballistic missile threats. Both the Army and Navy Theater Ballistic Missile Defense Programs will gain advanced interceptor capabilities from these technologies.

(U) **Military Communications:** (\$4.183 Million)

(U) Continue to investigate technology for global high-rate military communications and networking at rates from tens of megabits to tens of gigabits per second, including optical communications and tactical theater communications (particularly to Army forces on the move). Global ultra-high rate networking: Initiate test-bed demonstration of 100 Gps LAN and MAN for processing surveillance data, utilizing soliton optical pulses and optical processing (current state-of-the-art for electronic networks is ~2Gbps); demonstrate networking techniques and protocols for interconnection of disparate military communications systems. Milsatcom: Complete architecture for EHF Milsatcom beyond 2005, including sophisticated, agile and narrow RF beam steering, advanced low-power on-board signal processing, and new networking techniques to enable efficient computer communications over EHF Milsatcom; identify required technology developments. Tactical Satellite Terminals: Continue development of optically-controlled phased array antennas. Evaluate 4-element receive array at 8 GHz; continue development of integrated transmit and receive array (application to communications on-the-move to ground forces and to aircraft).

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(U) **Defensive Information Warfare:** Techniques for dynamic network reconfiguration will be refined, extended and demonstrated in the context of a large scale network, as a step towards developing technology for improved robustness in military C4I systems. The attack/anomalous usage simulation system will be extended beyond the Unix environment to embrace popular commercial operating systems, such as Windows NT, frequently used by the military. The development and refinement of algorithms for improved real time intrusion detection will continue, with preliminary evaluation in military base-protect operating environments.

(U) **Combat Support Technology:** (\$3.158 Million)

(U) **Hyperspectral Sensing Systems:** Extend the operating spectral region of both the white light “laser” and the spectral imaging systems to encompass the 1 to 2 micron and 3 to 5 micron bands. Continue processing algorithm development in order to identify key features for target recognition and visualization using the extended sensing capability. This system will be tested in both laboratory and field environments on a variety of targets and scenarios of military interest. Design of a full-spectral system, spanning the visible through infrared bands will be initiated and the factors affecting fusion with other sensing systems, such as synthetic-aperture radar, will be examined.

(U) **Biological Agent Detection Systems:** Field measurements and aerosol-chamber measurements will continue. Lab measurements will concentrate on growth media. Field measurements will broaden applications by measuring in and around buildings for counter-terrorism applications. Microfluidics technology work will focus on expanding the capability to design and fabricate complex structures for tissue-based sensors. Advanced laser and optical technology will be pursued to adapt the UV fluorescence sensor to other missions, e.g., release assessment after an attack on an underground structure. Modeling and simulation efforts will be expanded to integrate battlefield communications and biodetection sensor models in a detailed ModSAF simulation. These technology efforts will be flowed into the Army ATD on biological sensing, the Joint Biological Remote Early Warning System (JBREWS) ACTD, and into an expected follow-on Army ATD on a combined chemical, biological, nuclear sensor.

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(U) **Advanced Electronics Technology:** (\$6.836 Million)

(U) In support of digital receivers for advanced DoD sensors, demonstrate direct RF optical sampling (no down conversion) with A/D conversion at greater than 100 MHz bandwidth and 80 dB dynamic range. Transition baseline mid-IR semiconductor laser technology to industry for dual-wavelength IRCM systems. Continue development of tunable superconductive RF filters for frequency-agile receivers. Demonstrate 4-GHz bandwidth ELINT receiver incorporating superconductive chip filters and CMOS/SOI data processor. Explore micromechanical RF tuning structures for electronically reconfigurable microwave communications circuits. Commence development of AlGaN materials for avalanche photodiodes. Demonstrate controlled-impedance multi-chip module (MCM) with high-speed digital circuits. Reduce dark current levels and develop CMOS-based versions of visible, UV and IR focal planes in support of AF, DARPA, and other DoD programs. Continue development of advanced silicon digital and analog integrated circuits to support emerging DoD systems, with an emphasis on low-power/high-speed subsystems in MCMs. Extend SOI/CMOS to sub-200-nm feature size radiation hard process. Demonstrate tunable low-noise tapered lasers in the 1.3- μ m region for wavelength division multiplexed RF links. Continue development of bio-detector technology with emphasis on discrimination and identification methodologies. Demonstrate APD arrays for use at eye-safe wavelengths in 3-D ranging/imaging applications. Demonstrate 3-D radar subsystems incorporating a geiger-mode photodiode array, integrated timing electronics, and compact laser illuminator.

(U) **FY2000 Plans:**

(U) **Target Surveillance and Recognition:** (\$5.621 Million)

(U) **Surface Surveillance:**

(U) Complete development of multichannel airborne data collection capability. Formulate new sensor designs incorporating insights gained from development of fundamental ATR performance bounds and high-definition vector imaging (HDVI). Use synthetic foliage-penetrating radar imagery for initial validation of inverse-scattering-based target recognition. Develop algorithms for exploiting active seismic signatures of underground facilities and validate with subscale experimentation. In addition to being directly applicable to ongoing R&D efforts such as DARPA's DDB, MTE, FOPEN and Small Unit Operations programs, these activities will have considerable significance for organizations, such as NIMA, NRO and the Services, that are planning and developing next-generation exploitation and sensing systems.

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(U) **Space Surveillance:**

(U) Continue the development of advanced focal plane arrays in both visible and IR wavebands and in-pixel focal plane signal processing. Continue the development of 3-D laser radar for advanced seeker applications with the capability to scale the array size to greater than 32X32 pixels. The on-FPA processing technologies for both passive and active (LADAR) sensors promise significant improvements in performance and reductions in development and life cycles costs for future BMD interceptor systems for Navy Theater Area Defense and Theater Wide Defense.

(U) **Military Communications:** (\$4.724 Million)

(U) Continue to develop technology for global high-rate military communications and networking, including optical communications in space and fiber, future EHF Milsatcom architecture and technology, and tactical theater communications (particularly to Army forces on the move). Continue extension and demonstration of networking techniques and protocols for interworking among disparate networks including Milsatcom. Complete 100 Gbps optical LAN/MAN testbed (application to surveillance data processing). Continue demonstration of integrated transmit/receive phased array antenna system, and begin design of prototype system for future Milsatcom applications. Continue development of Milsatcom signal processing technology; continue laboratory demonstration of integrated on-board demodulation, switching, and routing techniques for next-generation EHF Milsatcom.

(U) Defensive Information Warfare: Prototype protocols for improved security and robustness to network attack in Internet environments will be developed and demonstrated in the context of a distributed collaborative planning application, as a further step towards more network attack-resilient military C4I systems. The development and evaluation of advanced techniques for network intrusion detection will be continued, with emphasis on the fusion of complementary data from an ensemble of cooperating intrusion detection systems, for improved aggregate performance.

(U) **Combat Support Technology:** (\$3.566 Million)

(U) Hyperspectral Sensing: Develop a full-spectral active HSI system, using select, discrete-frequency laser wavelengths throughout the visible through mid-wave IR spectral regions, broadband illumination in discreet segments of those regions, and passive long-wave IR imaging. The system will be adaptable, where both the sensing wavebands and target-recognition algorithms will be specified by the applications. For some applications, visible APD arrays will be incorporated that permit range-resolved imaging as well as the standard spatial and spectral imaging that the active HSI system affords. Effort will also be expended in developing real-time processing and visualization schemes for either direct relay to user or transmission to a control station for fusion of multiple sensing assets.

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(U) Biological Agent Detection Systems: Perform lab tests to explore integrating a UV fluorescence trigger sensor with a microfluidic biofilter and with a B-cell identifying sensor. Extend the modeling and simulation to develop advanced sensor-fusion algorithms and to look at simulation of combined Nuclear Biological Chemical (NBC) sensor. Explore how to adapt biological sensing processes (e.g., B-cell sensing) to non-living systems. This work will feed into the Army ATD and also into the Joint Biological Universal Detection (JBUD) system to be developed by the Joint Program Office for Biological Defense.

(U) **Advanced Electronics Technology:** (\$7.863 Million)

(U) Extend direct RF optical sampling to higher bandwidths by demonstrating scalable methods for parallelizing quantizers. Improve materials and spectral combining techniques enabling higher-brightness and higher- operating-temperature optically pumped mid-IR semiconductor lasers for IRCM applications. Continue development of advanced silicon process technology with extensions of CMOS to sub-100-nm feature sizes, with emphasis on development of technologies for on-focal processing, radiation hard technologies, and integrated sensors. Explore applications of visible and IR "expendable" imagers for unmanned observation post. Demonstrate micromechanically reconfigurable microwave ICs for frequency-agile receivers. Continue development of bio-detector technology with emphasis on compact, long duration sensors capable of rapid agent identification. Develop AlGaIn UV detectors for solar blind applications

(U) **FY 2001:**

(U) **Target Surveillance and Recognition:** (\$5.355 Million)

(U) **Surface Surveillance:**

(U) Use multichannel airborne data collection system to demonstrate wide-area, high-resolution, rapid-revisit GMTI with ECCM. Develop and apply absolute (vs. relative, between two sensor designs) fundamental ATR performance bounds. Use real foliage-penetrating radar imagery to validate inverse-scattering-based target recognition. Test exploitation of active-seismic underground-facility signatures with full-scale experimentation. In addition to being directly applicable to ongoing R&D efforts such as DARPA's DDB, MTE, FOPEN and Small Unit Operations programs, and to planning and development activities of NIMA, NRO and the Services, this activity will help develop and prove concepts crucial to creation of a true joint integrated air/ground picture

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(U) Space Surveillance

(U) Continue the development of 3-D laser radar technologies for advanced seeker applications. These include compact, high efficiency lasers, receiver FPA's and high sensitivity passive sensor FPA's for acquisition and handover to the LADAR. These advanced technology sensors will allow future ballistic missile defense interceptors to address very advanced missile threats which will include intentional countermeasures applied to both defense tracking radars as well as the IR interceptor seekers. The evolving Ballistic Missile Defense Organization (BMDO) Technology Readiness Roadmap specifically identifies these technology developments as high priority for future BMD systems by both Air Force, Army and Navy BMD Programs.

(U) Military Communications: (\$4.500 Million)

(U) Continue to develop technology for global high-rate military communications and networking, including optical communications in space and fiber, future Milsatcom architecture and technology, and tactical theater communications (particularly to Army forces on the move). Continue Laboratory demonstrations of technology for DoD-specific applications (particularly in EHF Milsatcom signal and antenna processing), refine networking architecture and protocols, complete integrated transmit/receive phased array antenna, and aid DoD in defining its development and procurement strategy for the future global defense network that will provide C3 and ISR product transport. Application is to the emerging integration of DoD command elements, information centers, and execution forces into a unified Global Information Grid.

(U) Defensive Information Warfare: Dynamic reconfiguration and improved security protocols will be integrated with state-of-the-art intrusion detection technology for adaptive real time reaction to network attacks. Intrusion detection strategies will be extended to focus on anomalous user behavior, with the objective of countering computer/network attacks mounted from inside the protected bastion perimeter. Transition of proven technology to military operating environments will be initiated.

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(U) Combat Support Technology: (\$3.398 Million)

(U) Hyperspectral Sensing Systems: Operational concepts will be developed during this phase of the 4-D hyperspectral sensor program for surface surveillance and reconnaissance to be operated on various platforms such as ground vehicles (including unattended ground sensors), UAVs and aircraft. The effort will focus on selected specific applications which will lead to the design and development of compact and/or miniaturized sensing systems, adaptive and automated real-time (or near real-time) processing algorithms, as well as protocols for communication and product dissemination.

(U) Biological Agent Detection Systems: Develop and test a fully integrated detection/identification system, including the required communications and data-fusion architectures. Explore how to integrate biological sensors with chemical and nuclear sensors. Begin to test sensors based on non-living systems.

(U) Advanced Electronics Technology: (\$7.486 Million)

(U) Investigate highly scaled CMOS/SOI digital circuits using mixed electron-beam and optical lithography at 25-nm feature sizes for ultradense circuits. Demonstrate compact and power efficient version of optically sampled A/D with multi-GHz bandwidth for radar and electronic intelligence use. Demonstrate highly integrated imager with digital output in optimized low-power-consumption configuration suitable for tactical image web and/or micro-air vehicle use. Continue development of UV, visible, IR and hyperspectral imaging devices with on-focal-plane processing for "smart" multimode sensors. Explore analog optical processing techniques to extend performance of compressive receivers to 10-GHz bandwidth for signal intercept. Extend micromechanically reconfigurable microwave circuits to high power for transmitter applications. Transfer advanced mid-IR semiconductor laser technology to industry for dual-wavelength IRCM. Continue development of solid-state devices, materials and processing subsystems in support of DoD programs.

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(U) B. <u>Program Change Summary</u>	<u>FY1998</u>	<u>FY1999</u>	<u>FY2000</u>	<u>FY2001</u>	<u>Total Cost</u>
Previous President's Budget	17.708	19.641	19.574	19.252	Continuing
Appropriated Value	18.474				Continuing
Adjustments to Appropriated Value					
a. Congressionally Directed undistributed reduction	(0.766)				
b. Rescission/Below-threshold Reprogramming, Inflation Adjustment					
c. Other			1.500	1.800	Continuing
Current President's Budget	17.708	19.641	21.074	21.052	Continuing

Change Summary Explanation:

(U) **Funding:** Changes in 1998 are based on Congressionally directed reduction. FY2000 and FY2001 was increased to extend the technology developed for chemical agent detection to include biological agent detection technology.

(U) **Schedule:** Not Applicable

(U) **Technical:** Not Applicable

(U) **C. OTHER PROGRAM FUNDING SUMMARY COST:** Not Applicable

(U) **D. ACQUISITION STRATEGY** Not Applicable

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(U) E. SCHEDULE PROFILE: Not Applicable

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